ORIGINAL (Red)

Expanded Site Inspection of the Pemco Corporation (MD-055)

~~**Draft**~~

Final
1/17/03 JAB

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1.0 Introduction

1.1 Authorization

This Expanded Site Inspection was performed by the Maryland Department of the Environment, Waste Management Administration (MDE/WAS), Environmental Restoration and Redevelopment Program (EERP), Site Assessment Division under the 2000 Cooperative Agreement with the U.S. Environmental Protection Agency (EPA).

1.2 Scope of Work

The MDE/WAS ERRP Site Assessment Division was contracted to perform an Expanded Site Inspection (ESI) of the Pemco Corporation (MD-055). The purpose of the ESI is to assess the actual and potential release of hazardous waste from the site by way of groundwater, surface water, soil exposure, and air pathways. The scope of the ESI included reviewing the available file information, a target survey, site reconnaissance, and sampling under the U.S. EPA Contract Laboratory Program (CLP).

1.3 Executive Summary and Conclusions

Pemco Corporation, located in Baltimore City, Maryland, has been a production facility for glass and porcelain since 1910. Until 1979, waste glass (frit) and porcelain was disposed of in a ravine that was located in the southwest portion of the site along an unnamed stream that discharges into the Patapsco River. Pemco Corporation came to the attention of the Maryland Water Resources Administration (WRA) in 1977 when it applied for a Designated Hazardous Substance (DHS) permit. On April 20,1979, Site Complaint SC-0-79-376 was issued to the Pemco facility because waste materials were disposed of in an area that impacted water of the state. On October 1, 1979, Supplemental Order SC-0-79-376-A was issued to Pemco which directed Pemco to cease and desist the disposal of hazardous material on-site, remove all piles of lead and heavy metal contaminated material, extend the existing storm drain pipe downstream of the landfilled area, regrade, cap and vegetate the landfilled area and submit analysis of all outfalls under the National Pollutant Discharge Elimination System (NPDES) permit. Supplemental Order SC-0-79-376-B was issued to Pemco on October 29, 1979 which updated the previous Order allowing Pemco more time to meet the directives in the previous Order. The Order objectives were met by the end of 1980.

Several sampling events at this site have revealed high levels of inorganic contamination, especially lead, in the on-site soils and sediments that exceed EPA's residential screening value and National Oceanic and Atmospheric Agency Screening Quick Reference Table (NOAA SQRT) Threshold Effects Level (TEL). The toxicological evaluation within this report revealed that the estimated carcinogenic risk from the ingestion of groundwater exceeds EPA's recommended level for the adult worker population.

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MDE has additional requirements for the Pemco site since the persistent seeps in the landfill cap may have established a pathway for the migration of landfill contaminants into an on-site stream. Also, a residential area borders the site and is situated close to the unnamed stream on site. Furthermore, the toxicological evaluation of the single groundwater sample collected for this report revealed an exceedance in the EPA recommended level of estimated carcinogenic risk from the ingestion of on-site groundwater The groundwater at the site should be fully characterized in order to determine the extent of contamination

2.0 Site Description

The 19.97-acres Pemco Corporation site is located at 5601 Eastern Avenue in Baltimore City, Maryland. The site is located on the south side of Eastern Avenue across from the Johns Hopkins Bayview Hospital. The property is bounded on the east by Bonsal Street and on the west by Umbra Street. This area of Baltimore City is comprised of a mixture of densely populated residential, commercial, and light industrial areas. The entire site is fenced and entry to the property is gained through a security gate off of Eastern Avenue. The Maryland grid coordinates are 529,100 feet north and 927,875 feet east. The geographic coordinates are 39° 17' 05" north latitude and 76° 33' 00" west longitude.

Production, storage, and research buildings dominate the eastern portion of the property. The northern portion of the site is paved for parking. Disposal took place in the western and southern portions of the site. This area was originally a ravine with a small unnamed stream flowing through it. By 1979, the fill in the ravine reached a height of forty feet and covered an area of approximately 4 acres. This inactive portion of the site has changed little since the extension of the storm drainpipe, installation of a 6-8 feet clay loam cap and revegetation of the area in 1979. There is however, a seep area at the southwest toe of the landfilled area that will not maintain vegetation and remains wet throughout the year. This seep may act as a conduit for heavy metals to reach the unnamed stream and be transported off-site.

2.1 Site Ownership and Site Use

The Pemco facility was originally owned and operated by Pemco Corporation. The Pemco name has remained with the facility throughout its operation. In 1955, the plant was then sold to the Glidden-Durkee Corporation which became a division of the SCM Corporation in 1967. In 1980, the SCM Corporation sold the plant to the Mobay Chemical Company. In 1992, the plant was transferred to Miles, Inc., which held the plant until1995 when it was sold to the Bayer Corporation. In October 1997, the plant was transferred to the Pemco Holding Corporation, the current owner of the site. During this entire period the facility has been used to manufacture glass and porcelain products by all of its owners. Until 1979, fine grain porcelain and glass wastes, known as frit, concrete, brick, nail, and metal fragments were disposed of in a ravine on the western portion of the site. An area of approximately four acres was filled to a depth of approximately 40 feet.

of the site. Once off-site, the stream enters a culvert that directs the flow beneath railroad tracks and I-95. The stream discharges from the culvert on the south side of I-95 onto the Mount Carmel Cemetery property and flows approximately 650' south before entering another culvert that directs the flow beneath O'Donnell Street and Interstate Avenue. The stream discharges from this culvert and flows approximately 600' southeast before entering a culvert that directs the flow in a easterly direction under Boston Street and I-95 where it discharges and flows for approximately 1,000' on the Canton Railyard property before entering another culvert. The stream appears to be redirected and discharges on the Canton Railyard property and flows south for approximately 3,000' before discharging into the Patapsco River immediately west of the Seagirt Marine Terminal. Overland flow from the non-paved areas of the property discharges to the stream at the southwestern portion of the site. Gutters capture the surface water runoff from the paved areas of the site and direct it towards the storm water drains along Eastern Avenue. The site is outside of the 500-year floodplain.

3.3 Soils

Most of the surface and near surface native soils have been reworked and are now covered by concrete, asphalt and imported fill.

3.4 Geology

The site is located in the Atlantic Coastal Plain province in an outcrop of the Arundel Clay. The Arundel Clay is a late Cretaceous, gray, brown, and black tough clay interbedded with small sand lenses that is estimated to be approximately 150 feet thick in this area and dips gently to the southeast. The formation is considered to be an aquiclude acting as a confining layer to the Patuxent Formation, a major water bearing unit in Maryland. The Patuxent consists of a series of irregular beds of Cretaceous age sands, sandy silts, and clays. The Patuxent outcrops approximately 3 miles west of the site and dips to the east, becoming progressively thicker. The Patuxent rests upon Baltimore Gneiss, crystalline bedrock of late Precambrian age.

3.5 Groundwater

Shallow groundwater at the site varies from near surface at the discharge area near the on-site stream, to 10-15 feet towards the eastern side of the site. This information was obtained from borings for the monitoring wells installed in 1979. The shallow groundwater in the vicinity of the former waste dump area is believed to be perched. There are two springs that emanate from the southwestern area at the toe of the former waste dump area and one on the southern end. The Patuxent Formation, a major water bearing source for Maryland, is approximately 150 feet below the site and is separated from shallow groundwater by the Arundel Clay Formation.

3.6 Meteorology

Baltimore has a temperate, subhumid climate. The average yearly temperature is 55°F. The average yearly precipitation is 45 inches, and the average evaporation is 36 inches.

3.7 Nearby Land Use and Population Distribution

The area surrounding the Pemco facility is used for industrial, commercial and residential purposes. The Johns Hopkins Bayview Hospital is situated north of the site, directly across Eastern Avenue. The NIH Gerontology Research Center, CERCLA site MD-494 is located at 4940 Eastern Avenue and is situated within the Bayview Hospital property. Manufacturing and commercial facilities are located to the east. Included with the commercial sites that lie to the east of the site are parcels once owned by the Sun Oil Corporation and EXXON Corporation. The Mount Carmel Cemetery is located south of I-95, which borders the southern portion of the site. Row homes are located on the western boundary of the site.

Major residential areas are located to the west in Highlandtown, and to the east and southeast in Eastwood, Graceland Park and O'Donnell Heights. The areas to the south and southwest of the site are area mainly industrial. According to the 1997 census information, the estimated population in Baltimore City is 657,256.

4.0 Waste Description

One of the major products of the Pemco facility is a shattered glass known in the ceramic industry as "frit". These frits are of proprietary composition that are basically made up from complex boro-silicates and may contain concentrations of lead, cadmium and other heavy and trace metals. From the time period between 1910 and 1979, porcelain, glass fines and frit have been disposed in the former on-site ravine. While there is no evidence of other hazardous wastes being in disposed in the dumpsite, it is possible that wastes other than frit, concrete, bricks, nails and metal fragments may have been disposed into the dump.

5.0 Previous Studies

In March 1979, the U.S. Department of Agriculture Science and Education Administration conducted soil analyses on gardens and related soils on Umbra Street at the request of the Southeast Community Organization. The samples were collected from both banks of the unnamed stream on the Pemco property. Results of the analysis revealed elevated levels of lead (up to 63,800 parts per million).

In May 1979, the WMA collected soil, surface water and groundwater samples in response to the Pemco DHS permit application. Elevated levels of arsenic, barium, cadmium, chromium and lead were detected in the soil, surface water and groundwater samples.

In February 1982, JRB Associates completed a *Hazardous Waste Site Assessment Report* that detailed historical data about the site and concluded with a concern for the potential of off-site migration of heavy metals and possibly caustics and solvents.

Also in 1982, the Maryland Department of Health and Mental Hygiene performed a *Preliminary Assessment* that addressed concerns related to the waste dumped into the ravine.

In 1984, NUS Corporation completed a *Site Inspection.* Samples from a shallow monitoring well revealed elevated levels of arsenic (62 ppb), cadmium (9.3 ppb), and lead (250 ppb). Samples collected from two seeps on the western and southern slopes of the landfill revealed lead (150 ppb) and cadmium (1.6 ppm). Since there were no apparent pathways for migration of these contaminants, the toxicological evaluation concluded that there was no threat to human health or the environment.

In 1999, the Maryland Department of the Environment (MDE) conducted a *Site Survey* recommending future investigation due to insufficient data concerning the discharge of contaminated groundwater from the landfilled area.

In April 2000, MDE personnel conducted a *Site Inspection* in response to the 1999 *Site Survey.* Results of the analyses are contained in tables in Section 6.0. Actual laboratory data is attached in Appendix A.

6.0 MDE CONTRACT LABORATORY PROGRAM (CLP) SAMPLING

MDE submitted a sampling plan proposal to the EPA Region III office in February 2000 for the proposed collection of groundwater, surface water, sediment, and soil at the site. The purpose of the sampling was to evaluate areas within and adjacent to the landfill for any potential contamination. EPA verbally approved the sampling proposal in March 2000.

MDE personnel conducted the sampling in April 2000 according to procedures outlined in EPA's CLP Routine Analytic Services as Case Number 28009. All samples were analyzed for Target Analytic List inorganics and Target Compound List organics (Appendix I). MDE collected the samples in four matrices: one organic aqueous, one organic solid, one inorganic aqueous, and one inorganic solid. Sampling procedures for groundwater, surface water, sediment, and soil are fully outlined in MDE's Standard Operating Procedures. Each matrix included the collection of a field duplicate sample and a matrix spike sample. A field blank consisting of deionized water prepared by MDE was provided for each aqueous matrix. MDE prepared trip blanks consisting of deionized water in 40 ml vials preserved with hydrochloric acid. These trip blanks were shipped and analyzed along with aqueous samples for volatile organic compounds. The sampling locations are shown section 6.5, and the sampling log is shown in the table on the following page.

SAMPLE SUMMARY TABLE

SAMPLE DESIGNATION	SAMPLE TYPE	SAMPLE LOCATION	RATIONALE
GW1 (refusal at 24')	Aqueous	Near storm sewer outfall at extreme SW portion of site below waste source.	Characterize on-site shallow groundwater discharging into nearby surface water.
SW1	Aqueous	Below the storm sewer outfall in the unnamed tributary at the extreme SW portion of the property.	Characterize on-site shallow groundwater downgradient from waste source. Probable point of entry into surface water
SW-1DM	Aqueous	See above.	Filtered sample.
S1	Soil	Extreme SW portion of the site, downgradient from the waste source.	Characterize on-site soil downgradient of the waste source.
SED1	Sediment	Below storm sewer outfall at SW property border.	Characterize on-site surface water most likely affected by the waste source.
GW2 (background)	Aqueous	Near SE corner of site.	Background for shallow groundwater.
GW-2DM	Aqueous	See above.	Filtered sample.
SW2 (background)	Aqueous	Storm management pond across Eastern Avenue at Bayview Hospital.	Background for on-site surface water.
SW-2DM	Aqueous	See above.	Filtered sample.
S2	Soil	See GW2	Background for on-site soil.
SED2 (spike)	Sediment	Perpetual seep located near the SW base of the landfill.	Characterize sediment affected by shallow groundwater flowing through the waste source.
SW3	Aqueous	See SED3.	Characterize off-site contaminant migration in surface water.
S3	Soil	Across the stream from S1	Characterize contamination migration across the unnamed tributary.
SED3	Sediment	South of the railroad tracks near entrance to culvert.	Characterize off-site contaminant migration and deposition.
SW4	Aqueous	At the terminus of storm drain culvert.	Representative of background and plant discharge water that has not contacted the waste source.
SW-4DM	Aqueous	See above.	Filtered sample.
S4	Soil	See S1.	Duplicate of S1.
SED5 (background)	Sediment	Storm management pond across Eastern Avenue at Bayview Hospital.	Background for stream sediment.
SW5	Aqueous	See SW1.	Duplicate of SW1.

6.1 Sampling Results

Summary of Inorganic Results in Soil and Sediment Samples

Analyte (mg/kg)	S-1	S-2 background	S-3	S-4	S-5	S-6	S-7	S-8
ALUMINUM	5110	5920	8650	8350	2690	9910	2470	3640
ANTIMONY					38.8		28.6	
ARSENIC	2.8	7.2	3.9	2.8	14.7	1.6	3.4	4.5
BARIUM	40	61	82	35	1020	124	45	55
BERYLLIUM	3.1	0.8	1	2.1				0.6
CADMIUM		2.7	1.8		165	1.1	22.1	0.5
CALCIUM	253	2770	2310	169	67700	13700	32700	3020
CHROMIUM	26	25	33	19	685	13	39	21
COBALT	17	9	11	14	22		13	5
COPPER	95.9	56	16.6	34.2	619	10.1	36.6	40.7
IRON	18100	26900	23100	16900	80900	6600	14800	17800
LEAD	30	93	73	9	26400	46	287	69
MAGNESIUM	253	1120	1630	644	27800	2190	14100	638
MANGANESE	55.3	166	507	75.8	1040	64	149	90.1
MERCURY								0.1
NICKEL	29	59	19	19	412	5	32	11
POTASSIUM	260	338	563	292	286	577	271	386
SELENIUM	0.3	0.9	0.4	0.2	0.5		0.4	0.4
SILVER					5		1	
SODIUM					751	315	747	
VANADIUM	48	45	45	34	68	19	11	32
ZINC	60	74	70	42	924	69	187	64

Highlighted values indicate concentrations above RBC for industrial soils and/or NOAA SQRT for freshwater sediment.

Summary of Inorganic Results in Groundwater and Surface Water Samples

Analyte (ug/L)	GW-2 background	SW-1	SW-2 background	SW-3 crisis	SW-4	SW-5 Dup of SW-4
ALUMINUM	9190		683			
ARSENIC	20					
CALCIUM	67200	39400	37900	44400	33800	44600
CHROMIUM	40	60				147
COPPER	30		38			29
IRON	58700	274	1930	171	356	301
LEAD	11	2	24	3	3	4
MAGNESIUM	61600	8800	7810	9760	8020	9380
MANGANESE	204	25	86	19	25	24
NICKEL	134					
POTASSIUM	3370	5110	4250	5800	4540	5110
SELENIUM	8	3		3	2	2
SODIUM	21600	69300	54900	80000	51800	87000
VANADIUM	77					
ZINC	81	30	70	29	28	55

Highlighted values indicate concentrations that exceed Maryland Toxic Substances Criteria for Ambient Surface Water.

Summary of VOC Detection in Soil, Sediment, Groundwater and Surface Water Samples

Analyte	SED-1 (ug/Kg)	SED-3 (ug/Kg)	SW-4 (ug/L)	SW-5 (ug/L)
2-BUTANONE	16 B	15 B		
ACETONE			18 J	31 J

Qualifiers: B = not detected substantially above laboratory or field blanks.
J = analyte present, the reported value may not be accurate nor precise.

There were no VOC analytes above benchmark levels in soil, sediment, groundwater and surface water samples.

Summary of SVOC Detection in Soil and Sediment Samples

Analyte (ug/Kg)	S-1	S-2 background	S-3	S-4	SED-1	SED-2 upstream	SED-3
1,1-BIPHENYL		810 J					
2-METHYLNAPHTHALENE		2100 J					
ACENAPHTHYLENE		1100 J					
ACENAPHTHENE		8400				1100 J	
ANTHRACENE		16000				2300 J	
BENZO[A]ANTHRACENE		22000	44 J		100 J	5700	44 J
BENZO[A]PYRENE		17000	42 J		120 J	5200	46 J
BENZO[B]FLUORANTHENE		23000	50 J		140 J	5300	
BENZO[G,H,I]PERYLENE		12000			60 J	3000 J	
BENZO[K]FLUORANTHENE		9500	50 J		130 J	4300 J	
BIS(2-ETHYLHEXYL)PHTHALATE	200 J		50 J	770		1700 J	78 J
BUTYLBENZYLPHTHALATE						790 J	
CARBAZOLE		16000				2200 J	
CHRYSENE		21000	62 J		160 J	6700	54 J
DIBENZO[A,H]ANTHRACENE		6000				1100 J	
DIBENZOFURAN		6000				750 J	
DIBUTYLPHTHALATE	48 B			44 B			
DIETHYLPHTHALATE							
DIOCTYLPHTHALATE					110 J		
FLUORANTHENE		42000	110 J		270 J	13000	94 J
FLUORENE		11000				1100 J	
INDENO[1,2,3-CD]PYRENE		14000			82 J	3300 J	
NAPHTHALENE		6400				630 J	
PHENANTHRENE		43000	77 J		140 J	10000	87 J
PYRENE		38000	92 J		260 J	10000	92 J

Qualifiers: J = analyte present, the reported value may not be accurate nor precise.

Highlighted values indicate concentrations that exceed RBC levels for industrial soil or NOAA SQRT levels for fresh water sediment.

Note: location S-2 is approximately 50 feet from a railroad spur into the Pemco property; SED-1 is less than 50 feet from an active railroad line; and location SED-3 is in a discharge area of a former oil-water separator.

Summary of SVOC Detection in Groundwater and Surface Water Samples

Analyte (ug/L)	FB-1	GW-2	SW-1	SW-2	SW-3	SW-4
DIBUTYLPHTHALATE	2 B	1 B	1 B	1 B	1 B	1 B
DIETHYLPHTHALATE	10					

Qualifiers: B = not detected substantially above laboratory or field blanks.

There was no detection of analytes above benchmark values for SVOCs in groundwater and surface water samples.

Summary of Pesticide and PCB Detection in Soil, Sediment, Groundwater and Surface Water Samples

Analyte (ug/Kg)	SED-1	SED-2	SED-3
4,4'-DDE		0.77 J	4.5 J
4,4'-DDT			17 J
ALPHA-CHLORDANE	3 J		10 J
DIELDRIN		1.1 J	3.9 J
ENDRIN KETONE			11 J
GAMMA-CHLORDANE	4.9 J		15 J

Qualifiers: J = analyte present, the reported value may not be accurate nor precise.
Highlighted values are above NOAA SQRT levels for fresh water sediment.

Summary of Inorganic Analytes Detected in Filtered Aqueous Samples

Analyte (ug/L)	FB-1DM	GW-2DM	SW-1DM	SW-2DM	SW-3DM	SW-4DM	SW-5DM
CALCIUM		65400	37800	35700	42400	33200	43100
CHROMIUM			45				124
IRON	144 C	190		293			
LEAD				3			
MAGNESIUM		60100	8560	7290	9310	7850	9060
MANGANESE		134	19		15	18	19
NICKEL		99					
POTASSIUM			4800	3740	5440	4160	4770
SELENIUM		8	3		E4	E3	E3
SODIUM		21200	65200	51600	75200	50200	81300
ZINC			20		25		30

Qualifiers: C and E = the value for the dissolved metals sample exceeded the total metals sample.

6.2 GROUNDWATER SAMPLING RESULTS

MDE collected one groundwater sample (GW-2), which was situated on what appeared to be a berm created for a railroad spur that serves the Pemco facility. Grab samples were collected from a temporary well utilizing Geoprobe® methods at a depth of approximately sixteen feet from a perched aquifer. Analysis results revealed low level inorganic contamination. Several attempts were made to obtain water from location GW-1 but were unsuccessful. A detailed explanation of the compounds detected in the groundwater samples is outlined in the toxicological section of the report.

6.3 SURFACE WATER/SEDIMENT SAMPLING RESULTS

MDE collected four surface water and four sediment grab samples. A filtered surface water sample was collected from each of the surface water sampling locations. The sediment sample locations were coincident with the surface water sampling locations. The chemicals in the surface water and sediment samples were screened against the Maryland Water Quality Criteria values and NOAA screening guidelines for freshwater sediment.

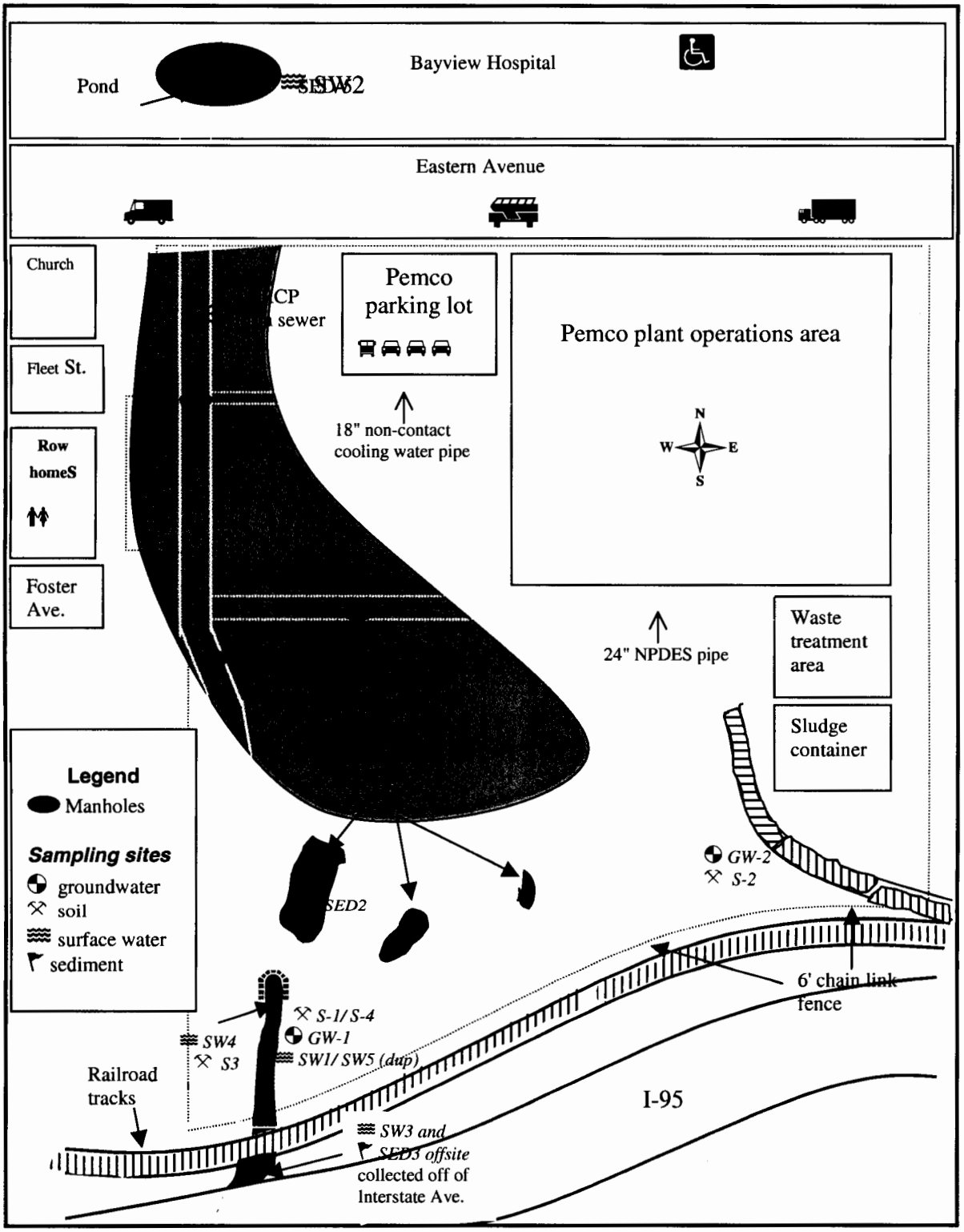
Surface water samples collected from the unnamed tributary onsite (SW-1, SW-4 and SW-5) revealed low levels of inorganic contamination and very low level acetone contamination. The surface water background sample, collected from a storm water management pond (SW-2) from which the on-site tributary emanates, and the downstream, off site sample (SW-3), revealed similar low level inorganic contamination that is not likely attributable to the Pemco landfill.

Sediment samples were collected on site from the tributary (SED-1) and from the landfill leachate (SED-2). Analysis of the samples revealed low level semi-volatile organic (SVOC), pesticide contamination, and inorganic contamination up to 26400 mg/Kg (SED-1). The background sediment sample (SED-5) and the downstream off site sediment sample (SED-3) that were collected in the vicinity of a former EXXON oil/water separator, revealed low level inorganic contamination and slightly elevated levels of SVOC contamination. The SVOC contamination detected at the off site location is not expected to be attributable to the Pemco landfill. A detailed explanation of the inorganic and organic compounds detected in the sediment samples is outlined in the toxicological section of the report.

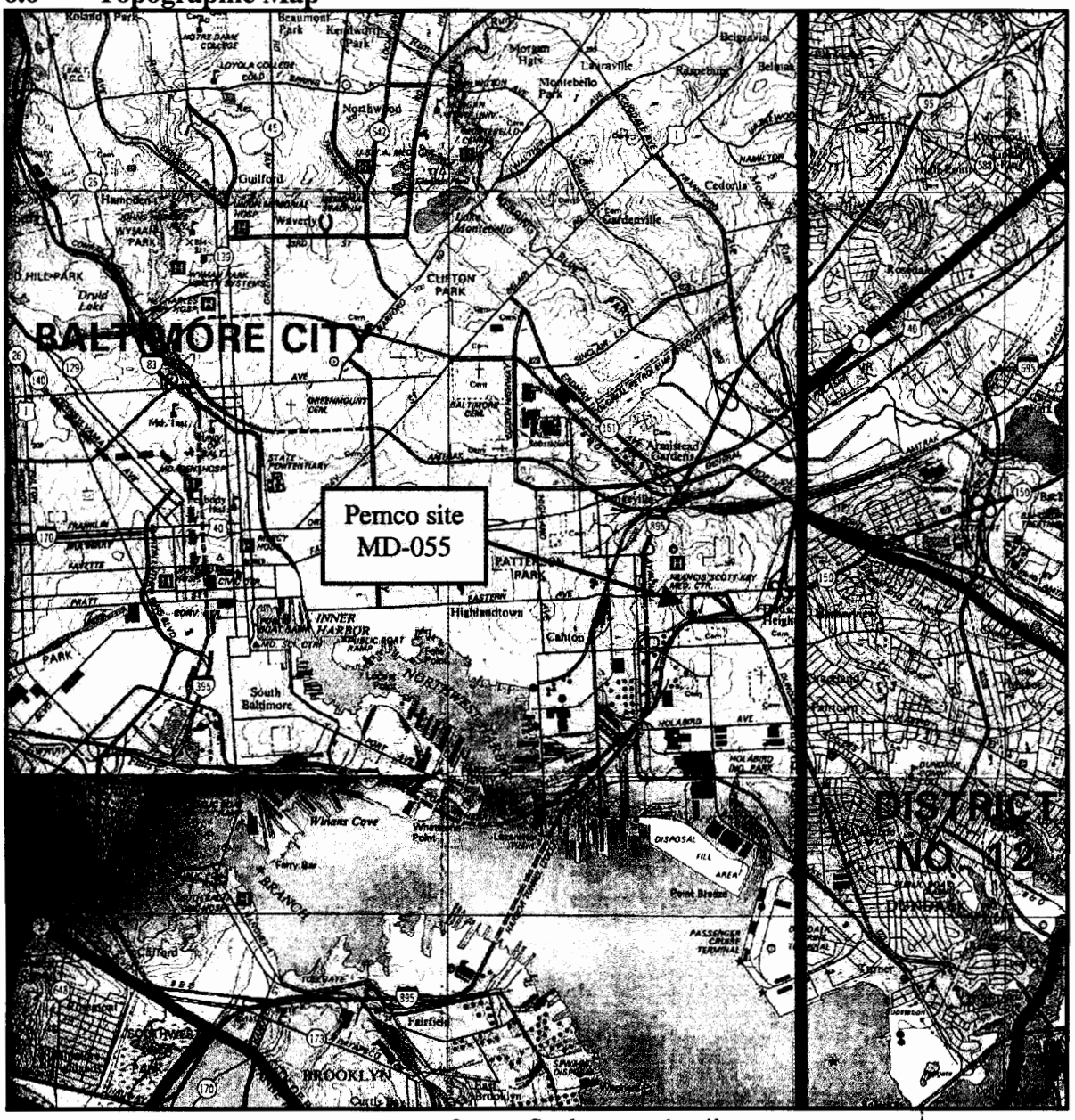
6.4 SOIL SAMPLING RESULTS

MDE collected four soil grab samples at depths to two feet using hand trowels or Geoprobe cores. Low level inorganic contamination was detected in the on site samples potentially impacted by the landfill (S-1 and S-3). The background sample (S-2) located upgradient from the landfilled area and near a railroad spur, revealed low level inorganic and SVOC contamination. The SVOC contamination detected at the background location is not expected to be attributable to the landfill. A detailed explanation of the inorganic and organic compounds detected in the on-site soil samples is outlined in the toxicological section of the report.

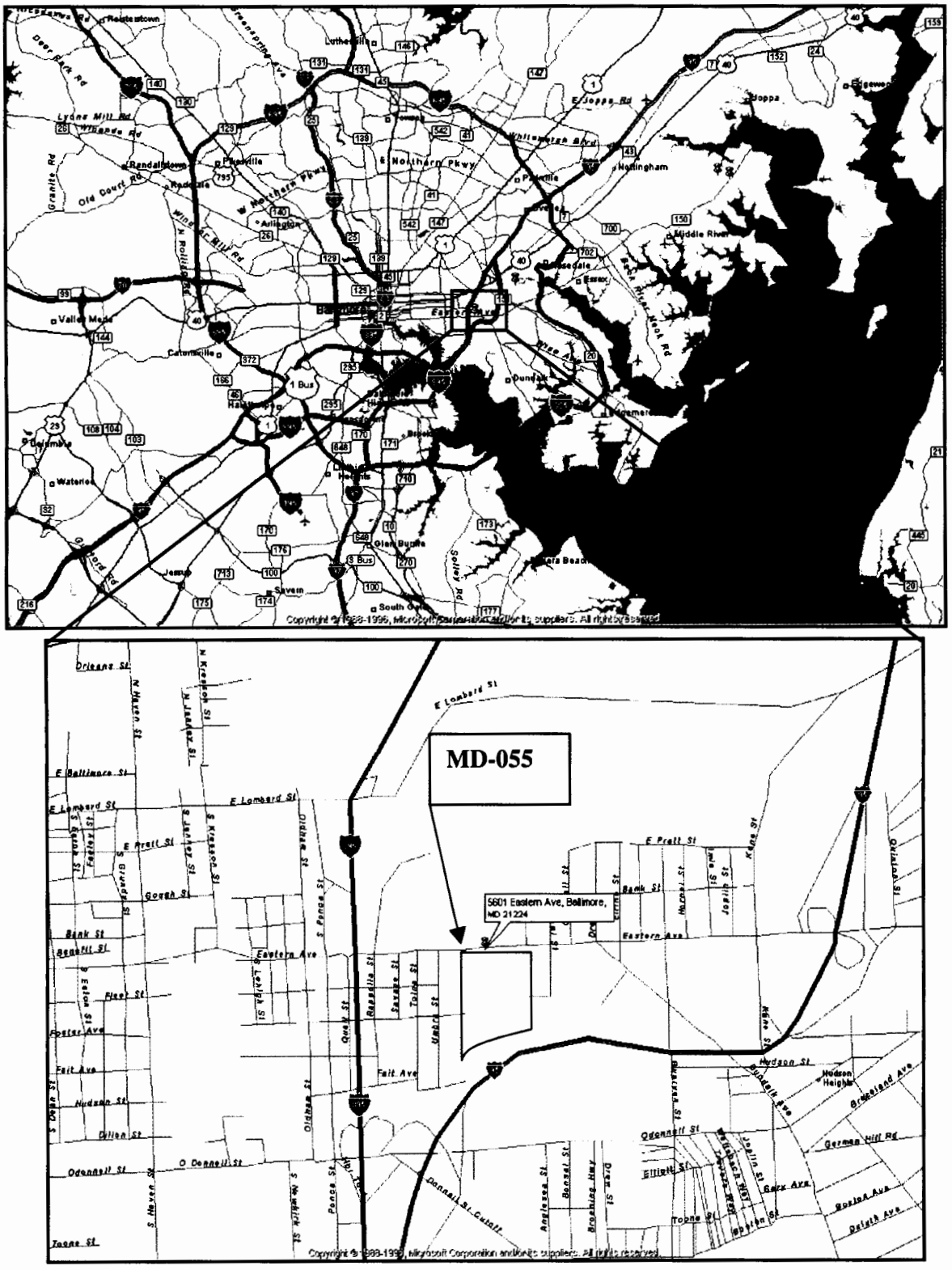
6.5 Site Sketch Pemco MD-055



6.6 Topographic Map



6.7 Regional and Local Map



7.0 TOXICOLOGICAL EVALUATION

Summary

This toxicological evaluation examines the human health risks associated with the Pemco Corporation (MD-055) site located at 5601 Eastern Ave in Baltimore City, Maryland. This site was evaluated for child intermittent visitor (1-6 years), youth intermittent visitor (6-17), adult worker and construction worker under a commercial future use scenario. The United States Environmental Protection Agency (USEPA) has recommended default exposure parameters that were used to estimate cumulative risk from all chemicals (1, 2, and 3). USEPA recognizes as an acceptable Hazard Index (HI) values less than or equal to 1 (noncarcinogenic chemicals) and excess lifetime cancer risk (CR) less than or equal to 10^{-6} to 10^{-4}. Risks to ecological receptors were evaluated by comparing groundwater and surface water contaminant concentrations to ambient surface water quality criteria. Based on these exposures, estimated risks at the site were compared to USEPA recommended levels, and the following conclusions were reached:

Summary table of HI values and CR values for each commercial population

Noncarcinogenic Endpoints			
Population	**Pathway**	**Hazard**	**Risk Drivers**
Child visitor	Ingestion – sediment	4	Potential additive effects
Construction worker	Ingestion – sediment	4	Potential additive effects
Construction worker	Ingestion – groundwater	3	Arsenic
Child visitor	Ingestion – groundwater	3	Arsenic
Youth visitor	Ingestion – groundwater	2	Potential additive effects
Carcinogenic Endpoints			
Population	**Pathway**	**Cancer Risk**	**Risk Drivers**
Adult worker	Ingestion – groundwater	1×10^{-4}	Arsenic

All calculated risk values were within USEPA recommended ranges.

Site Description

The Pemco Corporation (MD-055) site is approximately 19.97 acres total area. This toxicological evaluation will examine the risks to human health or the environment associated with historical site activities. Since 1910, use of the site consisted of glass and porcelain manufacturing. Until 1979, waste glass (frit) and porcelain were disposed of in a ravine located in the southwest portion of the site along an unnamed stream that

discharges into the Patapsco River. Production, storage and research buildings dominate the eastern portion of the property with disposal taking place in the western and southern portions of the site. By 1979, the fill in the ravine reached a height of forty feet and covered an area of approximately 4 acres. Remedial activities were performed on the site and completed by 1980, however, three seep areas located on the south and southwest toe areas of the fill exist. The seep may act as a conduit for heavy metals to reach the unnamed stream and be transported off-site.

Method

In evaluating risk to human health, maximum concentrations of all chemicals detected in surface soil, sediment, groundwater and surface water were compared to medium-specific screening levels (USEPA Region III Risk Based Concentration values). Chemicals that exceeded human health Risk Based Concentration (RBC) values were then evaluated quantitatively. Relevant toxicological data and RBC values from surrogate compounds (structurally similar analogues) were used for some of the chemicals with no corresponding RBC value. Groundwater data were collected from one direct push boring sample on the site. The evaluation of groundwater was performed as if the groundwater were being used as drinking water and the sample that contained the highest concentration of contaminants (the unfiltered sample) was used.

Human Health

Maximum detected concentrations of all chemicals detected in soils and sediments (dry weight values) were compared to the USEPA Region III Risk Based Concentrations (RBC) for residential soil (5). Comparison of dry weight analytical values to the RBCs is recognized as a conservative measure but provides consistency in risk assessments across sites (with variable soil moisture content) and sampling time. Groundwater and surface water maximum concentrations were compared to the USEPA Region III Risk Based Concentrations (RBCs) for tap water. Prior to comparison with each chemical concentration, noncarcinogenic RBCs were multiplied by 0.1, in order to account for any additivity of systemic effects. Carcinogenic RBC values were not adjusted and represent a target risk level of 10^{-6}. Any contaminant that exceeded its respective RBC screening level was then evaluated quantitatively. The quantitative evaluation was based on expected future use and development scenarios and includes populations typically expected to frequent the site based on this proposed future use.

The future land use at the site is commercial, therefore, the commercial scenario was used to evaluate risk at the site. The contaminants identified at the site at concentrations that exceeded residential RBCs were further evaluated with regard to risk to relevant populations under the following scenarios (1, 2, 3, and 7):

Commercial Development:

Adult Worker: 70 kg body weight, 3280 cm^2 skin surface area (soil), 5670 cm^2 skin surface area (groundwater), 0.05 skin adherence factor, 250 days per year exposure

for soil ingestion, 50 mg soil ingested per day, 0.833 m^3/hour inhalation rate, 8 hour exposure time (soil and groundwater), 25 year exposure duration, 70 year lifetime.

Construction Worker: 70 kg body weight, 3280 cm^2 skin surface area (soil), 5670 cm^2 skin surface area (groundwater), 0.05 skin adherence factor, 250 days per year exposure for soil ingestion, 480 mg soil ingested per day, 1.5 m^3/hour inhalation rate, 4 hour exposure time (groundwater), 1 year exposure duration, 70 year lifetime.

Youth Intermittent Visitor (6 - 17 years): 40 kg body weight, 4320 cm^2 skin surface area (soil), 13100 cm^2 skin surface area (groundwater), 0.02 skin adherence factor, 132 days per year exposure for soil ingestion, 100 mg soil ingested per day, 0.56 m^3/hour inhalation rate, 4 hour exposure time (soil ingestion), 0.5 hour exposure time (groundwater dermal contact), 12 year exposure duration, 70 year lifetime.

Child Intermittent Visitor (1 - 6 years): 15 kg body weight, 2350 cm^2 skin surface area (soil), 6560 cm^2 skin surface area (groundwater), 0.06 skin adherence factor, 132 days per year exposure for soil ingestion, 200 mg soil ingested per day, 0.32 m^3/hour inhalation rate, 4 hour exposure time (soil ingestion), 0.5 hour exposure time (groundwater dermal contact), 6 year exposure duration, 70 year lifetime.

Youth Swimmer (6 - 17 years): 40 kg body weight, 12 events per year, 50 ml water ingested per event, 1 hour exposure time per event, 12 year exposure duration, 70 year lifetime.

Child Swimmer (1 - 6 years): 15 kg body weight, 12 events per year, 50 ml water ingested per event, 1 hour exposure time per event, 6 year exposure duration, 70 year lifetime.

Human Health Evaluation

Soil, sediment, groundwater and surface water samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. Chemicals that were detected on site were compared to medium-specific screening levels (USEPA Region III RBC values). Chemicals that were not detected at the site and exceeded RBC values (at an assumed concentration of one half the detection level) were carried through the quantitative risk assessment but were not included in the summation of noncarcinogenic hazard quotients and carcinogenic cancer risk values. Chemicals detected at the site that exceeded human health RBC values were evaluated quantitatively using the maximum detected concentration as the site-wide average concentration. No RBC values were available for 4-bromophenyl phenyl ether, 4-chloro-3-methylhpenol, 4-chlorophenyl phenyl ether, bis(2-chloroethoxy)methane and cyclohexane, however, none of these chemicals were detected in any medium on site. Based upon historical site operations and the non-detection of these chemicals on site they were not included in the quantitative risk estimates.

The USEPA has issued a directive for lead that recommends a soil screening level of 400 mg/kg for residential scenarios at RCRA facilities and CERCLA sites and a drinking water action level of 15 ug/L for lead; the 400 mg/kg soil screening level and the 15 ug/L drinking water action level were used in this evaluation (5). Magnesium, calcium, potassium, iron and sodium are essential nutrients that were detected on site and are toxic only at very high concentrations. These compounds are found naturally in soils, therefore, they are not included in the quantitative risk estimates.

Soil

The chemicals detected in soil that exceeded the residential soil RBCs (i.e. failed the initial screening process, see Attachment A) were evaluated quantitatively. Soil exposures were evaluated via the ingestion, inhalation and dermal contact pathways. Reference dose (RfD) and cancer slope factor (CSF) values were obtained from USEPA Region III and IRIS (4, 6).

Sediment

The chemicals detected in sediment that exceeded the residential soil RBCs (i.e. failed the initial screening process) were evaluated quantitatively (Attachment A). Sediment exposures were evaluated via the ingestion, inhalation and dermal contact pathways. Sediments were conservatively evaluated using surface soil exposure scenarios. Reference dose (RfD) and cancer slope factor (CSF) values were obtained from USEPA Region III and IRIS (4, 6). Additionally, for comparative purposes only, sediment contaminant concentrations were compared to effects range-median (ERM) guidelines and NOAA threshold probable effects level (TEL) screening tables.

Groundwater

Groundwater samples from the site were analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. Contaminants that were detected above their respective RBC screening level were evaluated quantitatively for risk. Groundwater exposures were evaluated via the ingestion and dermal contact pathways. Estimates of noncarcinogenic and carcinogenic risks from dermal contact were calculated when sufficient data (permeability constants (10), oral absorbence efficiencies and dermal absorbence factors (11)) were available. Organic and inorganic contaminants detected in groundwater were also compared to their corresponding MCL (Maximum Contaminant Level). Groundwater contaminant concentrations were also compared to Maryland's ambient water quality standards (AWQS) and USEPA's recommended ambient water quality criteria (AWQC) for the protection of aquatic life and human health.

Surface Water

Surface water samples were analyzed for VOCs, SVOCs, pesticides, PCBs, and metals. Contaminants that were detected above their respective RBC screening level (Attachment A) were evaluated quantitatively for risk. Surface water exposures were

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evaluated via the incidental ingestion while swimming and dermal contact pathways. Maximum detected surface water concentrations were compared to Maryland's ambient water quality standards (AWQS) and USEPA's recommended ambient water quality criteria (AWQC) for the protection of aquatic life and human health.

Conclusion

Soil

The estimated noncarcinogenic and carcinogenic risk levels from the incidental ingestion of surface soil were within USEPA recommended levels for all commercial populations. The estimated noncarcinogenic and carcinogenic risks for all commercial populations from the inhalation of volatiles and fugitive dust, and dermal contact with surface soils were within acceptable risk levels as recommended by USEPA.

Sediment

The estimated noncarcinogenic risks for the child intermittent visitor and construction worker populations from the ingestion of sediment exceeded the USEPA recommended levels of risk. No individual risk drivers for noncarcinogenic effects were identified; the unacceptable risk levels were due to potential additive effects. The estimated carcinogenic risk levels from incidental ingestion of sediment were within USEPA recommended levels for all commercial populations. The estimated noncarcinogenic and carcinogenic risks for all commercial populations from the inhalation volatiles and fugitive dust and dermal contact with sediment were within acceptable risk levels as recommended by USEPA. Additionally, comparisons of sediment data to effects range-median (ERM) and threshold effects level (TEL) values were performed. Twenty analyte concentrations were greater than their ERM screening value and nineteen were greater than their TEL screening value. No RBC values for lead are available; however, the maximum concentration of lead detected in sediments was 26400 mg/kg, which exceeds the 400 mg/kg residential soil screening value, the ERM 218 mg/kg value, and the 35 mg/kg NOAA TEL for freshwater sediments. The concentration of lead and other metals in site sediment may pose a significant threat to human health and the environment.

Groundwater

Groundwater at the site is not used as a potable [redacted] and public drinking water is available. The evaluation of drinking water as a potable [redacted] is provided for comparative purposes only. The estimated noncarcinogenic risks from the ingestion of groundwater for construction worker, child visitor and youth visitor commercial populations exceeded the USEPA recommended levels of risk. Arsenic, detected in an unfiltered sample, was the noncarcinogenic risk driver for the construction worker and child visitor populations. Noncarcinogenic risks for the youth population was not driven by any specific risk but was driven by potential additive effects. Carcinogenic risk estimates for the ingestion of groundwater exceeded USEPA recommended levels for the

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adult worker population. Arsenic was identified as the risk driver for carcinogenic effects for the adult worker population. Dermal noncarcinogenic risk estimates were based solely on nickel, as this was the only detected analyte which all of the physical constants were available. The physical constants for estimating carcinogenic risk from dermal exposure to groundwater were not available, therefore, carcinogenic risk estimates for dermal contact with groundwater could not be calculated.

Groundwater contaminant concentrations were compared to available MCLs. One detected compound (nickel) was present in unfiltered groundwater at concentrations that exceeded the respective MCL. Groundwater contaminant concentrations were also compared to available ambient water quality standards (AWQS) or ambient water quality criteria (AWQC). Five groundwater contaminants, aluminum, chromium, copper, lead, and selenium exceeded the AWQS or AWQC for the protection of aquatic life and one analyte (arsenic) exceeded the recommended AWQC for the protection of human health. However, due to the minimal exceedances for these compounds it is not expected that the groundwater at the site would result in surface water exceedances of the applicable AWQS or AWQC.

Surface Water

The estimated noncarcinogenic risks for the youth and child visitor populations from the ingestion of surface water while swimming were within the USEPA recommended levels of risk. Carcinogenic risk estimates for the ingestion of surface water while swimming were within USEPA recommended levels for the child and youth visitor populations. The estimated noncarcinogenic risks for all future commercial populations from dermal exposure to surface water were within acceptable ranges as recommended by USEPA. The physical constants for estimating carcinogenic risk from dermal exposure to surface water were not available, therefore, carcinogenic risk estimates for dermal contact with surface water could not be calculated.

Surface water contaminant concentrations were also compared to available ambient water quality standards (AWQS) or ambient water quality criteria (AWQC). Four surface water contaminants, aluminum, chromium, copper and lead, exceeded the AWQS or AWQC for the protection of aquatic life and human health.

When determining whether an increased risk to human health exists at this site, it is important to understand that this evaluation was prepared as a first level screening evaluation. Many conservative assumptions are included in this evaluation, which were developed with the understanding that if the estimated risk, using the conservative assumptions, does not exceed USEPA's recommended levels, then the risk estimated using more realistic scenarios will not exceed these levels.

Since this evaluation includes many conservative assumptions, a risk that exceeds USEPA's recommended level of risk does not necessarily indicate an increased risk to human health. When this situation occurs, it is necessary to consider several points when determining if the risk actually does represent a threat to human health. For example, the

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quantitative risk estimate in this evaluation assumes people will be exposed to a contaminant at the maximum concentration all throughout the site and for the entire exposure duration. These assumptions do not take into account whether the maximum concentration is anomalous or characteristic of the site, or biodegradation, dispersion, dilution, or other factors which may decrease the contaminant concentration throughout the time of exposure.

This evaluation also assumes that the bioavailability of each contaminant is 100%, and that all of the contaminant taken into the body is absorbed across the digestive tract into the body. A chemical is harmful to human health only if it is absorbed into the body. Assuming complete bioavailability does not consider the fact that it is common for a fraction of the chemical taken into the body is excreted rather than being absorbed into the body. The bioavailability of a contaminant is dependent on many factors, such as the state or form of the contaminant and if the actual size of the contaminant particle would permit incidental ingestion. These issues must be considered when evaluating the appropriateness of assuming total bioavailability of a contaminant.

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Toxicological Evaluation References

1. USEPA. 1989. *Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A) Interim Final.* Office of Emergency and Remedial Response. EPA/540/1-89/002.

2. USEPA. 1991. *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual Supplemental Guidance "Standard Default Exposure Factors" Interim Final.* Office of Emergency and Remedial Response. OSWER Directive: 9285.6-03.

3. USEPA. 1991. *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk/based Preliminary Remediation Goals) Interim.* Office of Emergency and Remedial Response. EPA/540/R-92/003.

4. USEPA, Region III. Risk-Based Concentration Table, April 13, 2000.

5. USEPA. *Memorandum: Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities.* Office of Solid Waste and Emergency Response. OSWER Directive # 9355.4-12.

6. USEPA. Integrated Risk Information System. 2000.

7. USEPA. 1997. *Exposure Factors Handbook, Volume I, General Factors.* Office of Research and Development. EPA/600/P-95/002Fa.

8. Long, E.R., MacDonald, D.D., Smith, S.L., Calder, F.D., 1995. Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environmental Management Vol 19, No. 1, pp. 81-97.

9. NOAA. 1999. *Screening Quick Reference Table for Inorganics in Solids.* NOAA Hazmat Report 99-1.

10. USEPA. 1992. *Dermal Exposure Assessment: Principles and Applications.* EPA/600/8-91/011B.

11. USEPA. Region III, 1995. *Technical Guidance Manual, Risk Assessment, Assessing Dermal Exposure from Soil.* EPA/903-K-95-003.

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Comparison of Groundwater Concentrations to MCLs for the Pemco Corporation Site

Chemical	Maximum Concentration (ug/l)	MCL (ug/l)
Arsenic[a]	20	50
Chromium[a]	40	100
Copper	30	1300*
Lead	11	50[b]
Nickel	134	100
Selenium	8	50

[a]Arsenic as total arsenic and chromium as total chromium.
[b]Maryland Toxic Substances Criteria for Ambient Surface Waters (Drinking Water).
USEPA MCL action level is 15 ug/L.
Shading indicates the MCL has been exceeded.

Comparison of Groundwater Concentrations to Ambient Water Quality Criteria at the Pemco Corporation Site

Chemical	Maximum Concentration (ug/l)	Ambient Water Quality Standard (ug/l) For Use I Designation	
		Chronic Freshwater Aquatic Life[a]	Human Health[b]
Aluminum	9190	87	-
Arsenic	20	190[c]	0.14
Chromium (as Chromium VI)	40	11[c]	3400
Copper	30	12[c]	-
Lead	11	3.2[c]	-
Nickel	134	160[c]	3800
Selenium	8	5.0[c]	6800
Zinc	81	110[c]	-

[a]USEPA recommended ambient water quality criterion for the protection of aquatic life.
[b]USEPA recommended ambient water quality criterion for the protection of human health (fish consumption only).
[c]Maryland chronic ambient water quality standard for the protection of aquatic life.
Shading indicates a standard or criterion has been exceeded.

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Comparison of Surface Water Concentrations to Ambient Water Quality Criteria at the Pemco Corporation Site

Chemical	Maximum Concentration (ug/l)	Ambient Water Quality Standard (ug/l) For Use I Designation	
		Chronic Freshwater Aquatic Life	Human Health[b]
Aluminum	683	87[a]	-
Chromium (as Chromium VI)	147	11[a,c]	3400
Copper	38	12[a,c]	-
Lead	24	3.2[a,c]	-
	4	5.0[a,c]	6800
Zinc	70	110[a,c]	-

[a]USEPA recommended ambient water quality criterion for the protection of aquatic life.
[b]USEPA recommended ambient water quality criterion for the protection of human health (fish consumption only).
[c]Maryland chronic ambient water quality standard for the protection of aquatic life.
Shading indicates a standard or criterion has been exceeded.

Comparison of Sediment Concentrations to ERMs at the Pemco Corporation Site

Chemical	Maximum Concentration (mg/kg)	ERM Concentration (mg/kg)	TEL Concentration (mg/kg)
Arsenic	14.7	70	5.9
Cadmium	165	9.6	0.596
Chromium	685	370	37.3
Copper	619	270	35.7
Lead	26400	218	35
Mercury	0.10	0.71	0.174
Nickel	412	51.6	18
Silver	5	3.7	--
Zinc	924	410	123.1
Acenaphthene	1.1	0.50	--
Acenaphthylene	2.4[a]	0.64	--
Anthracene	2.3	1.1	--
Flourene	1.1	0.54	--
2-Methyl naphthalene	2.4[a]	0.67	--

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Naphthalene	0.63	2.1	--
Phenanthrene	10	1.5	0.0419
Benz(a)anthracene	5.7	1.6	0.0317
Benzo(a)pyrene	5.2	1.6	0.0319
Chrysene	6.7	2.8	0.0571
Dibenzo(a,h)anthracene	1.1	0.26	--
Flouranthene	13	5.1	0.111
Pyrene	10	2.6	0.053
DDE	0.0045	0.027	0.00142
DDT	0.017	0.046	0.00698
DDD	0.0024[a]	--	0.00354
Dieldrin	0.0039	--	0.00285
Endrin	0.0024[a]	--	0.00267
Gamma-BHC (Lindane)	0.00125[a]	--	0.00094
Gamma-chlordane	0.015	--	0.0045
Heptachlor epoxide	0.00125[a]	--	0.0006

[a]Not detected at site. Concentration represents one half the detection limit.
Shading indicates a standard or criterion has been exceeded.

ORIGINAL (RED)

8.0 Refrences

1.0 Maryland Department of the Environment *miscellaneous files.*

2.0 JRB Associates, *Hazardous Waste Site Assessment Report Pemco Products*, February 20, 1982.

3.0 Maryland Department of the Environment, *Site Survey of Pemco Products,* September 1999.

4.0 NUS Corporation, *Site Inspection of Pemco Products*, December 31, 1984.

5.0 Department of Natural Resources, Maryland Geological Survey, *Characteristics of Streamflow in Maryland, Report of Investigations No. 35*, 1983.

6.0 Maryland Department of Assessments and Taxation, 2000, Real Property Information for 5601 Eastern avenue, Baltimore, Maryland 21214.

7.0 U.S. Geological Survey, 1974, Topographic Map of Baltimore East 7.5- Minute Quadrangle, Baltimore, Maryland, Scale 1: 24,000.

8.0 U.S. Environmental Protection Agency, *Risk-Based Concentration Tables*, Region III, April 2000.

9.0 National Oceanic and Atmospheric Administration, *Screening Quick Reference Tables*, September 1999.

10.0 Maryland Department of the Environment, *Code of Regulations, Title 26, Volume XXIV, Part 2, Subtitles 08-12*, 26.08.02.03-2.

11.0 Federal Emergency Management Agency, *Flood Insurance Rate Map*, Community-Parcel No. 240087-0012D, revised September 30, 1988.

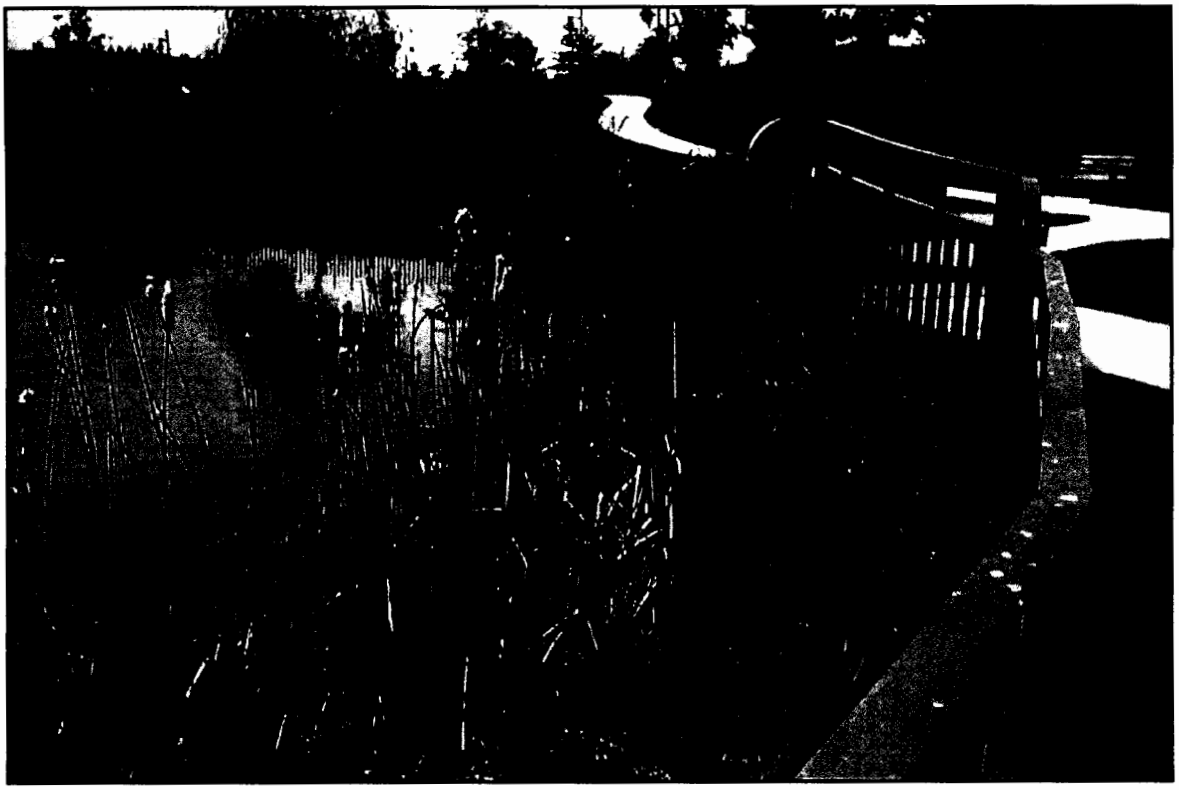
12.0 U.S. Department of the Interior, Fish and Wildlife Service, *National Wetland Inventory Map, Baltimore East*, 7.5-Minute Quadrangle, April 1981. Scale 1:24,000.

13.0 Microsoft, *Automap Streets Plus*, 1997.

14.0 U.S. Census Bureau, 1999 Population Estimates, web page http://www.census.gov/population/estimates/county/co-99-1/99C1_24.txt.

9.0 Photographs of Sampling Locations

Photograph of GW-2 and S-2 background locations, facing southwest towards the stream.



Photograph of SW-2 and SED-5 background locations on Bayview Hospital property.

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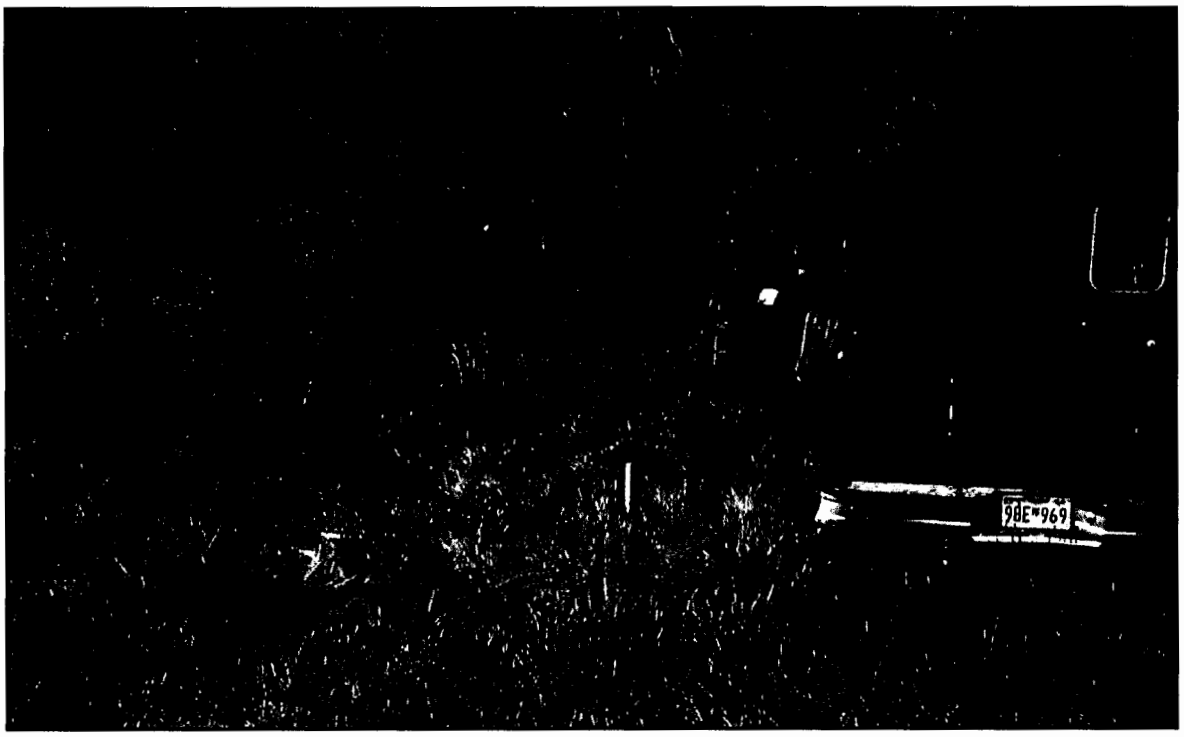

Photograph of GW-1 location downgradient from the toe of the landfill.

Photograph of the second GW-1 location approximately 100 feet east from initial GW-1.

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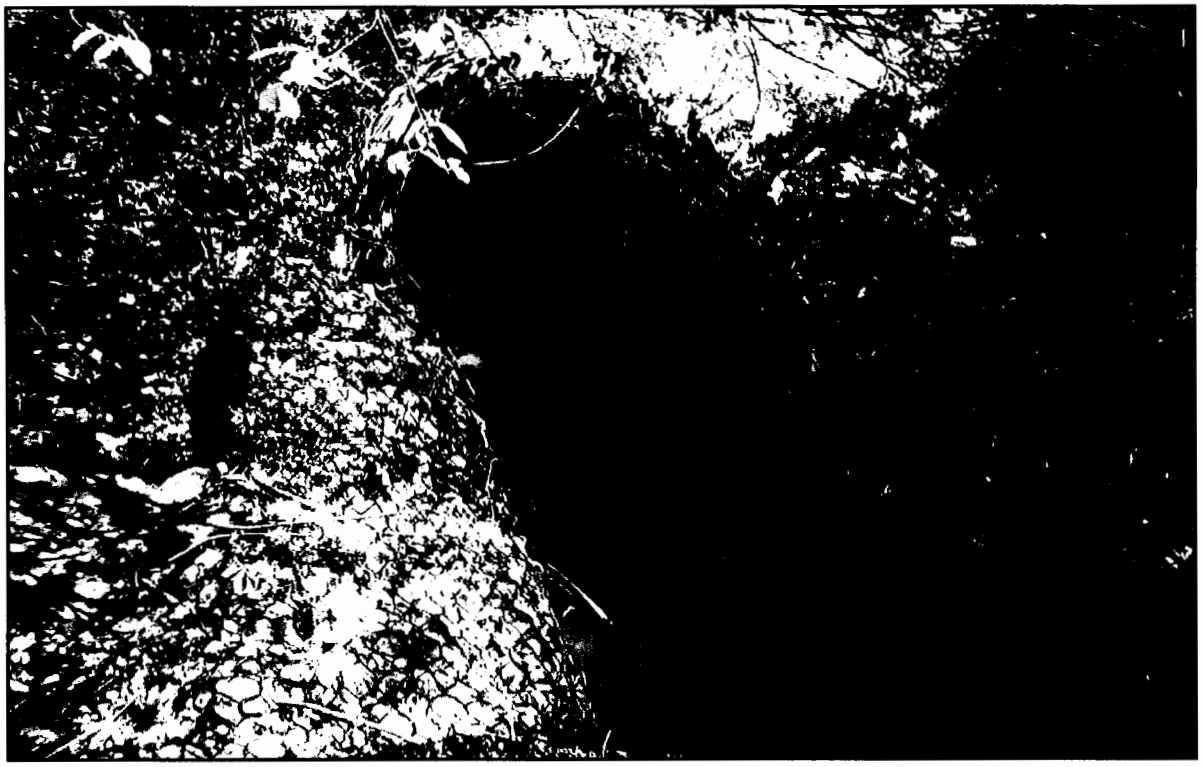

Photograph of the unnamed stream outfall form the concrete drainage pipe, SW-4.

Photograph of SW-1, SW-5 and SED-1 location approximately 30 feet from outfall.

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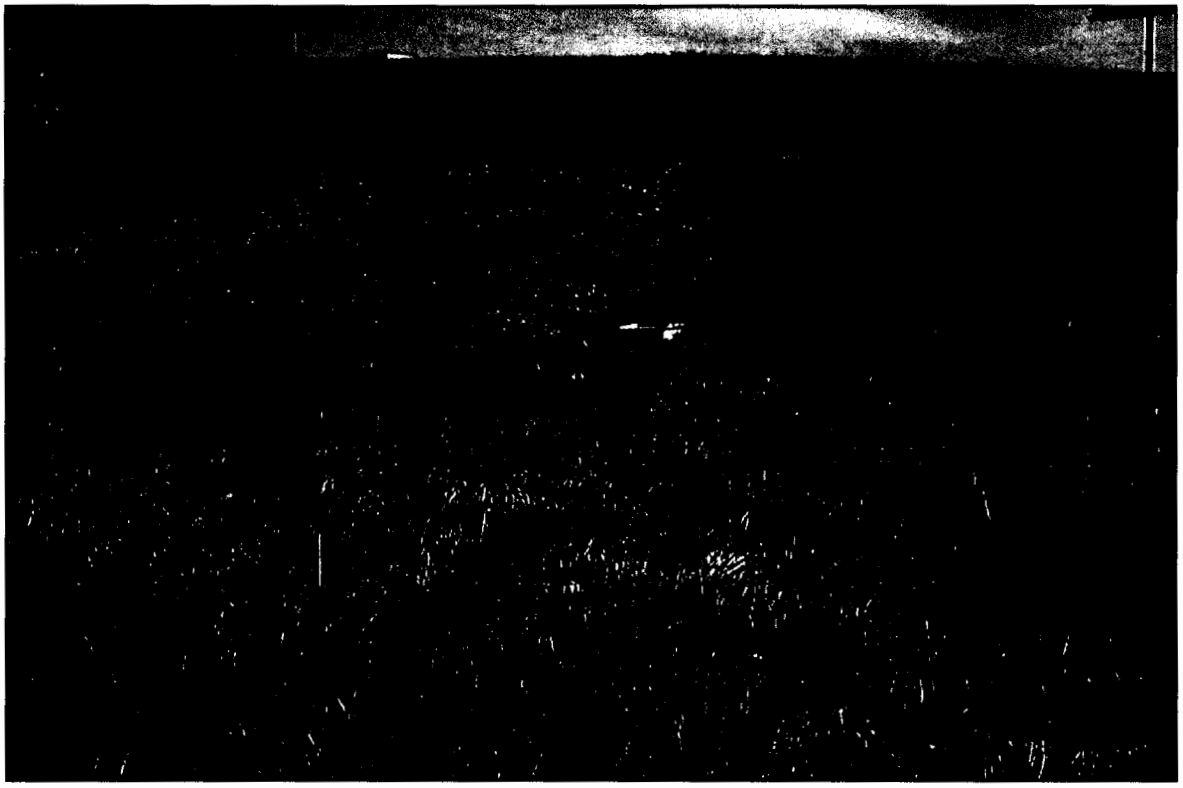

Photograph of the leachate seep from the southwest corner of the landfill, SED-2.

Photograph of location S-3, which is about 15 feet up, on the western bank of the stream.

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Photograph of SED-3 and SW-3 located just off Interstate Avenue near a former EXXON oil/water separator. The location is approximately 2000 feet downstream from the landfill.

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APPENDIX I

ORIGINAL (REC)

TARGET COMPOUND LIST

PESTICIDES AND PCBS

Aldrin
alpha-BHC
beta-BHC
gamma-BHC (Lindane)
delta-BHC
alpha-Chlordane
gamma-Chlordane
4,4-DDT
4,4-DDE
4,4-DDD
Dieldrin
Endosulfan
Endosulfan I
Endosulfan II
Endosulfan sulfate
Endrin
Endrin aldehyde
Endrin ketone
Heptachlor
Heptachlor epoxide
Methoxychlor
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260
Toxaphene

ORIGINAL

TARGET ANALYTE LIST

INORGANICS

Aluminum
Antimony
Arsenic
Barium
Beryllium
Cadmium
Calcium
Chromium
Cobalt
Copper
Cyanide
Iron
Lead
Magnesium
Manganese
Mercury
Nickel
Potassium
Selenium
Silver
Thallium
Sodium
Vanadium
Zinc

TARGET COMPOUND LIST

VOLATILES

Acetone
Benzene
Bromodichloromethane
Bromoform
Bromomethane
2-Butanone
Carbon Disulfide
Carbon Tetrachloride
Chlorodibromomethane
Chlorobenzene
Chloroethane
Chloroform
Chloromethane
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethene
total-1,2-Dichloroethene
1,2-Dichloropropane
cis-1,2-Dichloropropene
trans-1,3-Dichloropropene
Ethylbenzene
2-Hexanone
Methylene Chloride
4-Methyl-2-Pentanone
Styrene
1,1,2,2-Tetrachloroethane
Tetrachloroethene
Toluene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethene
Vinyl acetate
Vinyl chloride
Xylene (total)

TARGET COMPOUND LIST

SEMIVOLATILES

Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(g,h,I) perylene
Benzoic Acid
Benzyl alcohol
Bis(2-chloroethyl)ether
Bis(2-chloroethoxy)methane
Bis(2-chloroisopropyl)ether
Bis(2-Ethylhexyl) phthalate
4-Bromophenyl phenyl ether
Butylbenzylphthalate
4-Chloroaniline
4-Chloro-3-methylphenol
2-Chloronaphthalene
2-Chlorophenol
4-Chlorophenol phenyl ether
Chrysene
Dibenzo(a,h)anthracene
Dibenzofuran
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
3-3-Dichlorobenzidine
2,4-Dichlorophenol
Diethyl phthalate
2,4-Dimethylphenol
Di-n-butylphthalate
4,6-Dinitro-2-methylphenol
2,4-Dinitrophenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Dimethylphthalate
Di-n-octylphthalate
Fluoranthene
Fluorene
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Indeno(1,2,3-cd) pyrene
Isophorone
2-Methylnaphthalene
2-Methylphenol
4-Methylphenol
Naphthalene
2-Nitroaniline
3-Nitroaniline
4-Nitroaniline
Nitrobenzene
2-Nitrophenol
4-Nitrophenol
N-Nitrosodiphenylamine
N-Nitroso-di-n-propylamine
Pentachlorophenol
Phenanthrene
Phenol
Pyrene
1,2,4-Trichlorobenzene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol